

Observations on *Hipponix conicus* (SCHUMACHER, 1817)

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(Plate 41; 3 Text figures)

SPECIMENS OF THE PARASITIC protandrous hermaphrodite *Hipponix conicus* (SCHUMACHER, 1817) utilized in this study were collected in Fiji, Tonga and the Niue Islands. The specimens occurred as an associated male-female pair in all three localities, parasitic on *Conus mustelinus* HWASS in BRUGUIÈRE, 1792, *Mitra coffea* SCHUBERT & WAGNER, 1829, *Strigatella decurtata* (REEVE, 1844) and *Bursa granularis* (RÖDING, 1798). The four hermaphroditic specimens were attached directly to *Mitra coffea*, *M. stictica* (LINK, 1807), *Conus striatus* LINNAEUS, 1758 and *C. omaria* HWASS in BRUGUIÈRE, 1792.

All specimens were collected in shallow water, from 0 to 5 feet in depth. The specimens examined were as shown in Table 1.

Fijian specimens of *Hipponix conicus* were examined in the living state, while the Tongan and Niue Island specimens were received preserved in spirits. A *post mortem* change in preserved specimens was a uniform brown discoloration of all soft parts. The six female specimens, all twice as large as the small males, and the four hermaphroditic specimens were attached to the shell-surface of their host; the seven small males were sedentary on the females.

TAXONOMY

Hipponix DEFRANCE, 1819

1817. *Amalthea* SCHUMACHER, Essai nouv. syst., pp. 56, 181.—Type species by SD (GRAY, 1847) *A. conica* SCHUMACHER, 1817 (non *Amalthea* RAFINESQUE, 1815)
1819. *Hipponix* DEFRANCE, Journ. Physique et Chim. 8: 217—Type species by OD "*H. mitrata* GMELIN" (error for *mitrula* GMELIN, 1791) = *Hipponix antiquatus* (LINNAEUS, 1767)
1819. *Hipponyx* [sic] DEFRANCE, BLAINVILLE, Bull. Sci. Soc. Philom., p. 9
1841. *Sabia* GRAY, Syn. Cont. Brit. Mus. ed. 43, p. 126 [nom. nud.]
1842. *Sabia* GRAY, Syn. Cont. Brit. Mus. ed. 44, p. 90 [nom. nud.]
1847. *Sabia* GRAY, Proc. Zool. Soc. London, p. 157—Type species by OD *Amalthea conica* SCHUMACHER, 1817
1906. *Malluvium* MELVILL, Proc. Malac. Soc. London 7: 81-84
Type species by OD *Capulus lissus* E. A. SMITH, 1894

Table 1

Specimen No.	Size in mm	Sex	Spawn	Host species	Position	Locality ¹
1	20.5	♀	+	<i>C. mustelinus</i>	apex of spire	F
2	11.5	♀	+	<i>B. granularis</i>	body whorl	F
3	11.3	♀	+	<i>S. decurtata</i>	body whorl	N
4	10.7	♀	+	<i>M. coffea</i>	labial lip	T
5	10.1	♀	+	<i>M. coffea</i>	penult whorl	T
6	9.5	♀	+	<i>M. coffea</i>	antepen. whorl	T
7	9.4	♀	—	<i>C. striatus</i>	spire	F
8	8.0	♀	—	<i>C. omaria</i>	spire	F
9	7.8	♀	—	<i>M. stictica</i>	penult whorl	N
10	7.6	♀	—	<i>M. coffea</i>	labial lip	T
11	4.9	♂	—	<i>H. conicus</i> ♀	dextral side	N
12	4.9	♂	—	<i>H. conicus</i> ♀	dextral side	F
13	4.4	♂	—	<i>H. conicus</i> ♀	dextral side	T
14	4.2	♂	—	<i>H. conicus</i> ♀	dextral side	F
15	3.7	♂	—	<i>H. conicus</i> ♀	dextral side	T
16	3.3	♂	—	<i>H. conicus</i> ♀	dextral side	T
17	2.2	♂	—	<i>H. conicus</i> ♀	dextral side	F

¹ F — Fiji; N — Niue Island; T — Tonga Island

Hipponix conicus (SCHUMACHER, 1817)

1817. *Amalthea conica* SCHUMACHER, Essai nouv. syst. p. 181, pl. 21, figs 4a, 4b, 4c
1819. *Patella australis* LAMARCK, Anim. sans vert. 6: 335
1830. ? *Pileopsis palcaeca* MENKE, Syn. meth. Moll., p. 147

SCHUMACHER, 1817, established *Amalthea* for the species *A. conica* SCHUMACHER, 1817 and *A. maxima* SCHUMACHER, 1817 [= *Capulus ungaricus* (LINNAEUS, 1758)]. *Capulus ungaricus* (LINNAEUS) has already been appropriated as the type-species of *Capulus* MONTFORT, 1810,

and *Amalthea conica* was subsequently designated by GRAY (1847, p. 157) as the type species of *Amalthea*. SCHUMACHER's genus name, however, is a homonym of *Amalthea* RAFINESQUE, 1815, and therefore not available.

The DEFRANCE reference appears to be a scarce journal which is not available to me and is lacking in the Australian and Auckland Museums; entries have been compiled from SHERBORN (1902 - 1933) and E. A. SMITH (1906). SMITH, who obviously consulted the original reference, states that "*Hipponix mitrata* GMELIN," which presumably is a *lapsus* for *H. mitrula* (GMELIN), was designated as the type-species of *Hipponix* by DEFRANCE in the original publication. *Hipponix mitrula* (GMELIN) is synonymous with *H. antiquatus* (LINNAEUS). "*Hipponyx*" BLAINVILLE is only a misspelling of *Hipponix* DEFRANCE in a later publication (*vide* synonymy). Since the type-species of *Hipponix* has been originally designated, GRAY's subsequent designation (op. cit., p. 157) of *Patella cornucopiae* LAMARCK, 1803 (Eocene fossil from the Paris Basin) as the type species of *Hipponix* is invalid.

GRAY (op. cit., p. 157) established the genus *Sabia* through publication in synonymy of *Amalthea* SCHUMACHER; the type-species therefore is also *A. conica* SCHUMACHER by original designation. GRAY himself quoted *Sabia* as of 1833, but this reference appears untraceable; on two occasions *Sabia* appeared as a *nomen nudum*.

MELVILL, 1906, established *Malluvium* as a subgenus of *Amalthea* SCHUMACHER for the deep-water species *Capulus lissus* E. A. SMITH, from the Bay of Bengal. The author laid stress on the absence of radiating sculpture of *C. lissus*, which he stated is present in all specimens of either *Amalthea* SCHUMACHER or *Capulus* MONTFORT. SMITH (op. cit.) regarded MELVILL's *Malluvium* as "premature if not unnecessary," and correctly pointed out that the presence or absence of a concentric or radial sculpture in this group of species is hardly sufficient for the erection of a new subgenus. SMITH's contention must be supported in view of the presence of smooth and heavily ribbed or concentrically lamellated specimens of *Hipponix conicus* in even the short series of specimens used in this study. THIELE, 1903, figured the radula of "*Hipponix lissus*," which is basically similar to the radula of *H. conicus*, and included it in the family Capulidae. E. A. SMITH (op. cit.) remarked that Professor Gwatkin studied the radulae of *Capulus lissus* and pronounced them to be nearest *Amalthea* SCHUMACHER.

Taxonomy on the specific level appears to be equally confused in view of the great variability of conchological characters, i. e. colour, form and sculpture of *Hipponix conicus*; several currently acceptable specific names may

prove to be synonyms in a detailed comparison survey. E. A. SMITH (op. cit.) synonymized *Patella australis* LAMARCK with *Hipponix conicus*, and regarded LAMARCK's name to be of prior date without mentioning the year of authorship. I was unable to trace *Patella australis* LAMARCK prior to 1819. THIELE, 1925, equates *H. acutus* QUOY & GAIMARD, 1835 with *H. conicus* (SCHUMACHER).

There is no unanimity of opinion among malacologists as to a suprageneric classification of the group of related hermaphroditic taenioglossate gastropods. THIELE, 1929, placed the cap-shaped, non-operculate parasitic and hermaphroditic Amaltheidae (= Hipponicidae) together with operculate, spirally coiled and sometimes viviparous Fossaridae, and operculate and dioecious Vanikoroidae in the superfamily Amaltheacea (= Hipponiceacea). Families with similar shells, anatomy, oviposition and sexes to the Hipponicidae, e. g. Capulidae and Calyptraeidae, were placed by THIELE with operculate and dioecious Trichotropidae and operculate Amaplocamidae in the superfamily Calyptraeacea.

Hipponicidae show a considerable similarity to Capulidae: they are similar in shell-form, having a high-peaked, cap-shaped shell which lacks an internal apical plate. Both are sedentary parasitic or semi-parasitic hermaphrodites, with the females retaining their brood within the shell and veligers spawning as echinospiral veligers. Their radulae are so similar that in other groups of gastropods they would not be considered to exceed generic level. Species of the hipponicid genus *Cheilea* MODEER, 1793, are more dissimilar to *Hipponix* than the latter is to *Capulus*. *Cheilea* species are parasitic on rocks, the animal's proboscis is slender and longer and lacks the side-flaps near the mouth; the rachidians of the radula are wing-shaped, and the interior of the shell has an horse-shoe shaped, moderately long and shelly plate extension; females retain their spawn within the shell, and males are often found attached to the females.

The difference between Capulidae and Hipponicidae appears to be mainly in the mode of feeding and host selection. *Capulus* is reported to be a ciliary feeder and generally prefers bivalves for hosts. SCHEPMAN, 1909, however, reports *C. danieli* CROSSE, 1858, attached to "*Gyrineum cuspidatum* REEVE." These differences are few and doubtfully exceed family or superfamily level of classification. The present classification appears to be a retention of an orthodox taxonomic arrangement and not a superfamilial separation based on tangible evidence. *Hipponix conicus* would be more appropriately placed somewhere close to Capulidae, within the superfamily Calyptraeacea, and not in the Hipponiceacea.

THE SHELL AND POSITION OF ATTACHMENT

The species *Hipponix conicus* is rather variable in form, colour and sculpture. The outline of the shell margin generally corresponds with the shell-surface of its host. Some specimens are high and cap-shaped, with a curved and obsolete coiled apex which protrudes slightly over the posterior shell margin; other specimens are oval, elliptical, round or irregularly pentagonal in outline from a ventral view. The apex can be displaced as much as $\frac{1}{3}$ of the shell-length towards the centre, and viewed in profile some specimens appear rather depressed. Shells are sculptured with 15 - 34 flattened radial ribs, while in some small males ribs are completely absent. The concentric lamellations and coiled apex are generally obsolete in female shells, but quite distinct in some males; the radial ribs form a scalloped shell-margin. The exterior of the shell is either white, dirty grey, partly white and reddish-brown or white with reddish-brown rays. The interior of the shell is either pure white, white with orange muscle-scars, white with brown stains towards the apex or bluish-white with traces of brown muscle scars. Females are twice as large as the males, and hermaphroditic specimens are only slightly smaller than the females.

In all specimens examined, the females and hermaphrodites were attached directly to their hosts while the small males were sedentary on the females. The female will occupy almost any position on the host's shell-surface, with the exception of the area on the dorsal centre axis. The small males were fastened to the dextral side of the female

shell, and close to the shell margin, with the apex facing in the general direction of the female's apical region. Prominent scars are left on the host which correspond closely to the internal anatomy of the parasite. The scalloped shell margin is clearly indented in the host's shell-surface, the surrounding area is shallow and oval and rises to a small elevated plateau which has a central depression for the reception of the foot. The same type of scars are visible on the female *Hipponix* where the males were attached.

Restricted locomotion is evident in the species prior to reaching the required position of final immobility; one small male was somewhat too far away from the female's shell margin and subsequently moved into position, leaving a well-defined track in the female's shell-surface. HARTLEY (1958) discussed locomotion of *Hipponix conicus* and illustrated tracks of the species on the dorsal surface of *Haliotis ruber* LEACH, 1815. Once in position, it appears that the animal becomes immobile and temporarily sedentary. There is no evidence of hole-boring in *Hipponix conicus*; the small hole visible near the anterior margin of the labial lip on *Mitra coffea* is irregular, and has been caused through the softening process of the animal's body during deposition on a thin part of the host's shell.

THE ANIMAL

The animal's foot is small, disc-like, and fawn in colour; the mantle and horseshoe shaped muscle are yellow in colour. The head is long when extended, thick and brownish-grey in colour; two short, curved and pointed flaps

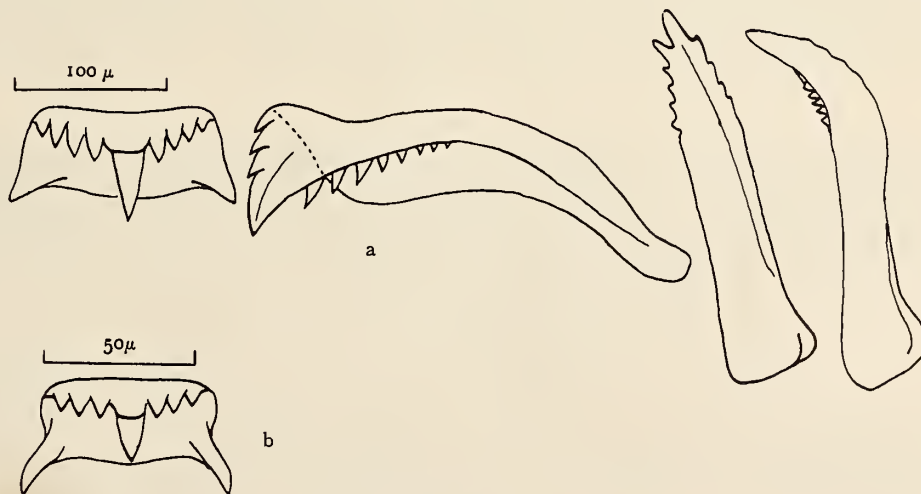


Figure 1

Hipponix conicus (SCHUMACHER)

a. Half row of radular teeth of female specimen No. 1

b. Rhachidian of radula of male specimen No. 14

Fiji Islands

are situated on each side of the animal's head. The head moves steadily from side to side and at times exposes the proboscis, displaying the whole length of the radular ribbon, vertically to the axis of the body, from the roof of the mouth to the floor of the mouth. Tentacles are long, moderately stout, yellow in colour, and either laterally streaked with purplish-brown or fully dark purple at the distal end. Eyes are small and simple and placed dorsally on the body near the junction of the tentacles and close to the tentacle's margin. The penis, where observed, was either moderately short or rudimentary, and cream in colour. An operculum is absent.

THE RADULA

The radula is taenioglossate, short and broad in the female, translucent-white in colour, formula 2·1·1·1·2. Rhachidians are broader than they are long, and equipped with a long central cusp which extends past the plate-margin; four smaller accessory cusps are positioned on either side of the main cusp. Lateral teeth are very broad, with a large main cusp and eight accessory denticles on the cutting edge of the main cusp. Inner marginals have six denticles, outer marginals about 5 denticles on the cutting edge of the main cusp. The female's radular ribbon measured 1.70 mm in length, 0.74 mm in width in an animal with a shell 20.5 mm in length; the ribbon contained 32 fully formed rows of teeth and 6 nascentes. Considerable wear on the teeth was evident in the front rows and persisted to the 12th anterior row. The considerable wear on the teeth and rather large proportion of nascentes to fully formed teeth would indicate frequent use of the radula on hard substratum.

The radulae of small males differ in minor but significant points from those of the females. In one male the radular ribbon measured 1.12 mm in length and 0.26 mm in width in an animal with a shell 4.2 mm in length; radulae of other males differ only slightly in proportion. The rhachidians of the radula have a slightly shorter central cusp and only three accessory denticles, while the laterals have only seven denticles on the cutting edge. The

marginal pegs on rhachidians are longer and more prominent, and the ribbon contains about 53 rows of fully formed teeth and only 1 to 2 nascentes.

The radular ribbon of the males is longer in proportion to shell-length than that of the female (male: 37.5% of length; female 12% of length), and the ribbon is more

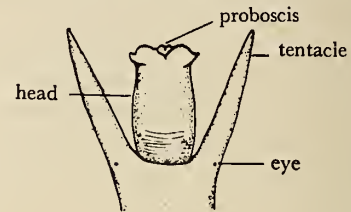


Figure 2

Hipponix conicus (SCHUMACHER)

Dorsal view of anterior part of animal

slender in proportion to total ribbon-length (male: 23%; female: 43%). No wear whatsoever was evident in the male radulae and the cusps of the first anterior row were as sharp as those in subsequent rows; the number of nascentes is reduced accordingly.

EGG CAPSULES AND VELIGERS

Egg-capsules are retained within the parent's body and are attached to the underside of the animal. Six females contained spawn, while only brood-sacs were present in hermaphroditic specimens. The female specimen from Fiji contained 36 elongated, vase-shaped capsules which are translucent-cream in colour; each capsule contained on the average 300 ova, which would be about 11 000 ova in the spawn. Capsules were attached by fine but strong filaments to a central brood-sac, which contained round ova of varying sizes, measuring from 15 μ - 30 μ . Eggs in the capsules were in different stages of development, some having reached an early veliger stage, while others were in the trochophore phase. Both trochophores and veligers measured from 120 μ - 150 μ . Early veligers had a cepha-

Explanation of Plate 41

Figure 1: Ventral view of living animal of *Hipponix conicus* (SCHUMACHER): view of female specimen No. 1, showing egg capsules, tentacles and extended head. $\times 4.0$

Figure 2: Female *Hipponix conicus* specimen No. 1 carrying male specimen No. 12, *in situ* on *Conus mustelinus* HWASS in BRUGUIÈRE $\times 1.3$

Figure 3: Female *Hipponix conicus* specimen No. 4 carrying male specimen No. 13, and hermaphroditic specimen No. 10 attached to labial lip margin of *Mitra coffea* SCHUBERT & WAGNER. $\times 2.5$

Figure 4: Etched out shell-scars on *Mitra coffea* after removal of *Hipponix conicus* specimens. $\times 2.6$

Figure 5: Dorsal and ventral view of female *Hipponix conicus* specimen No. 5 carrying male specimen No. 15. $\times 2.5$

Figure 6: Lateral view of specimens No. 5 and No. 15. $\times 2.5$

Figure 7: Dorsal and ventral view of female *Hipponix conicus* specimen No. 1 carrying male specimen No. 12. $\times 2.1$

Figure 9: Lateral view of specimens No. 1 and No. 12. $\times 2.1$



Figure 1



Figure 2



Figure 3



Figure 4

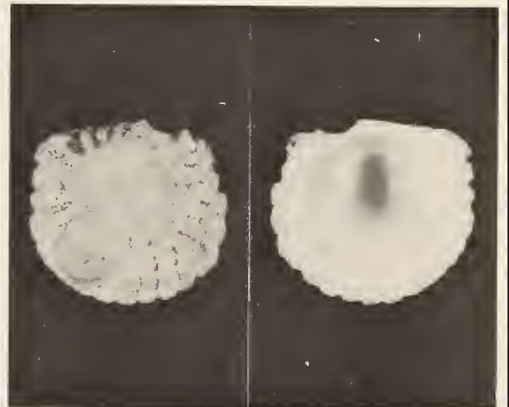


Figure 5



Figure 6



Figure 7



Figure 8

